LBI-38505A
(Supercedes LBI-30025)

Maintenance Manual

MASTR® II
BASE STATION
406-512 MHz RECEIVER

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ERICSSON

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Printed in U.S.A.

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ILLUSTRATIONS

SPECIFICATIONS*

Audio Output (to 8-ohm Speaker)	1 Watt at less than 3% distortion	
Sensitivity	With Pre-Ampl	Without Pre-Ampl
12 dB SINAD (EIA Method)	0.20 µV	0.35 µV
20 dB Quieting Method	0.25 µV	0.50 µV
SELECTIVITY		
EIA Two-Signal Method (25 kHz Spacing)	-90 dB	-90 dB
Spurious Response	-90 dB	-100 dB
Intermodulation (EIA)	-75 dB	-80 dB
Squelch Sensitivity		
Critical Squelch	0.25 µV	0.1 µV
Maximum Squelch	Greater than 12 dB NQ (less than 1.0 µV)	
Frequency Stability		
2C-ICOMs	±0.0002% (-40°C to +70°C)	
Modulation Acceptance	±7 kHz (narrow-band)	

Maximum Frequency Separation	Full Specifications	3 dB Degradation
406-470 MHz	1.60 MHz	2.0 MHz
470-494 MHz	1.50 MHz	2.0 MHz
494-512 MHz	1.50 MHz	2.0 MHz

Frequency Response	Within +2 and -8 dB of a standard 6 dB per octave de-emphasis curve from 300 to 3000 Hz (1000 Hz reference)
RF Input Impedance	50 ohms

*These specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

WARNING

Although the highest DC voltage in MASTR II receiver is +12 Volts DC, high current may be drawn under short circuit conditions. These currents can possibly heat metal objects such as tools, rings, watchbands, etc., enough to cause burns. Be careful when working near energized circuits!

High-level RF energy in the transmitter Power Amplifier assembly can cause RF burns upon contact. Keep away from these circuits when the transmitter is energized!

LBI-38505

DESCRIPTION

MASTR II Base Station, 406 to 512 megahertz receivers are single conversion, superheterodyne FM receivers designed for one-through eight-frequency operation. The solid state receiver utilizes integrated circuits (ICs), monolithic crystal filters and discrete components with each of the crystal filters located between gain stages to provide 100 dB selectivity and maximum protection from de-sensitization and intermodulation.

The receiver consists of the following modules:

- RF Assembly (Includes Mixer)
- IF-Filter
- Oscillator/Multiplier (Osc/Mult)
- IF/Audio and Squelch (IFAS)
- Optional Ultra-High Sensitivity (UHS) Pre-Amplifier

Audio, supply voltages and control functions are connected to the system board through P903 on the Osc/Mult board, and P904 on the IFAS board. The regulated +10 Volts is used for all receiver stages except the audio PA stage which operates from the A+ system supply.

Centralized metering jack J601 on the IFAS board is provided for use with Test Set 4EX3A11 or Test Kit 4EX8K12. The test set meters the oscillator, multiplier, IF Detector and IF amplifier stages. Speaker high and low are metered on the system board metering jack.

A block diagram of the complete receiver is shown in Figure 2.

Refer to the appropriate Maintenance Manual for complete details on each receiver module listed in the Table of Contents.

MAINTENANCE

DISASSEMBLY

To service the Receiver from the top (see Mechanical Parts Breakdown):

1. Pull the locking handle down, then pry up the top cover at the front notch and lift off the cover.

To service the Receiver from the bottom:

1. Pull the locking handle down and pull the radio out of the mounting frame.

2. Remove the top cover, then loosen the two bottom cover retaining screws and remove the bottom cover (see Figure 1).

3. To gain access to the bottom of the Osc/Mult and IFAS board, remove the six screws (A) holding the receiver bottom cover (see Figure 3).

NOTE

Refer to Figure 4 for receiver module location.

To remove the OSC/Mult board from the radio:

1. Remove the six screws (A) holding the receiver bottom cover.

2. Remove the eight screws (E) holding the IF-Filter bottom cover.

3. Remove the four screws (B) holding the board.

4. Press straight down on the plug-in Osc/Mult board from the top to avoid bending the pins when unplugging the board from the system board jack.

To remove the IFAS board from the radio:

1. Remove the six screws (A) holding the bottom cover, and the one screw (C) holding the board.

2. Remove the two screws (D) holding the audio PA heatsink to the right side rail.

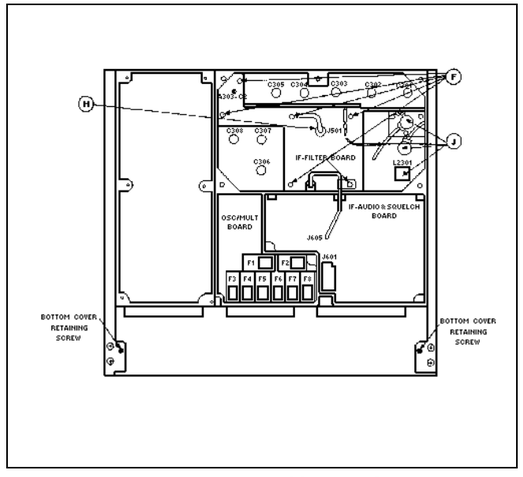


Figure 1 - Disassembly Procedure (Top View)

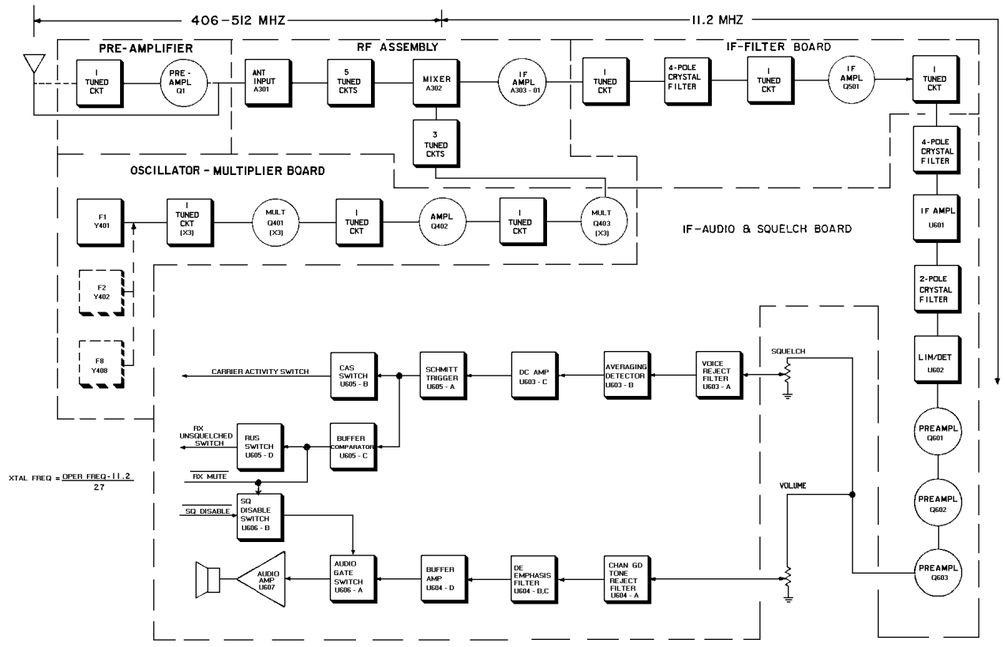


Figure 2 - Receiver Block Diagram

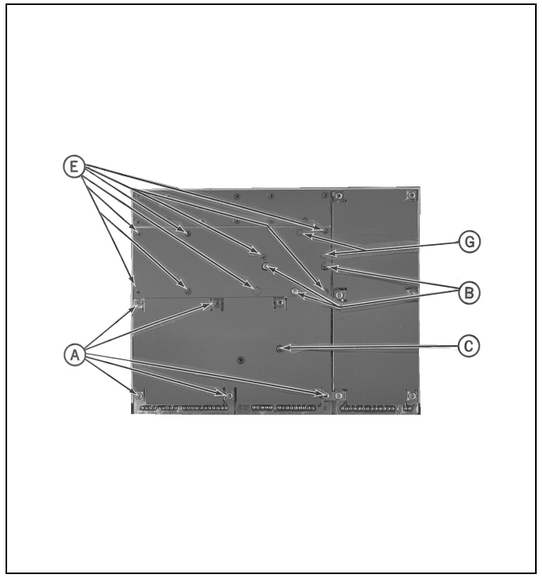


Figure 3 - Disassembly Procedure
(Bottom View)

To remove the IF Filter board from the radio:

1. Remove the eight screws (E) holding the IF Filter bottom cover.
2. Remove the six screws (F) holding the IF Filter top cover.
3. Remove the three screws (G) and the Connector (H), and carefully push down on the top of the board to avoid damaging the feedthrough capacitors.

To remove the optional UHS pre-amplifier board:

1. Remove the eight screws (E) holding the IF Filter bottom cover, and the six screws (F) holding the IF Filter top cover.
2. Disconnect the two connectors and 10 Volt lead (J).
3. Remove the three screws on the bottom side of the board, and lift out the board.

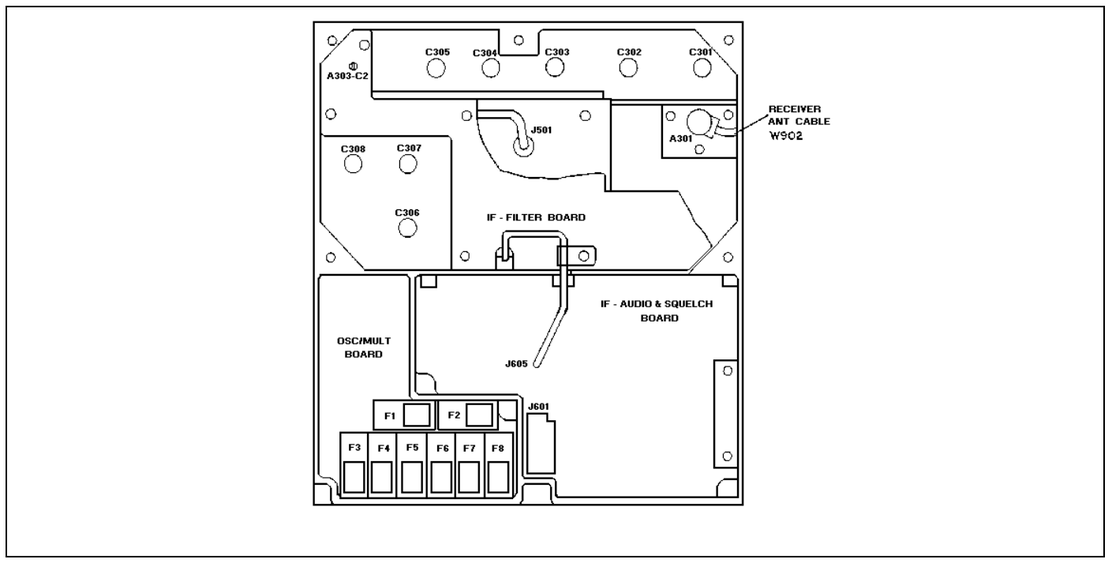


Figure 4 - Receiver Module Location Diagram

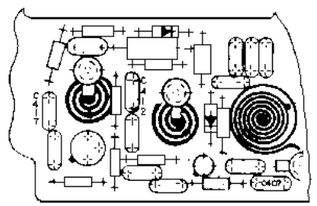
MODIFICATION INSTRUCTIONS FOR UHF HIGH SIDE INJECTION APPLYING 19A130045G5 KIT. THIS MODIFICATION IS NOT REQUIRED FOR RECEIVERS OPERATING IN THE FOLLOWING RANGES.

450 TO 458.8 MHz
470 TO 482.8 MHz
494 TO 500.8 MHz

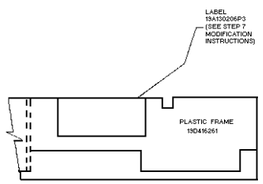
1. FOR RECEIVERS OPERATING BETWEEN 458.8 TO 470 MHz (OSC/MULT BD'S 19D423266G2 & G6):
   A. IF THE RECEIVER HAS LESS THAN 8 ICOMS, REMOVE C407, C412, C417. REPLACE C407 WITH C2315 (13 pF, -N80). REPLACE C412 WITH C2316 (5pF, NPO).
   B. IF THE RECEIVER HAS MORE THAN 8 ICOMS, REMOVE C407, C412, C417. REPLACE C407 WITH C2317 (8pF, N80). REPLACE C412 WITH 2316 (5pF, NPO)
2. FOR RECEIVERS OPERATING BETWEEN 482.8 TO 494 MHz (OSC/MULT BD'S 19D423266G3 & G7):
   A. IF THE RECEIVER HAS LESS THAN 8 ICOMS, REMOVE C407, C412, C417. REPLACE C407 WITH C2318 (10pF, N80). REPLACE C412 WITH C2319 (4pF, NPO).
   B. IF THE RECEIVER HAS MORE THAN 8 ICOMS, REMOVE C407, C412, C417. REPLACE C407 WITH C2320 (6pF, N80). REPLACE C412 WITH C2319 (4pF, NPO).
3. FOR RECEIVERS OPERATING BETWEEN 500.8 TO 512.0 MHz (OSC/MULT BD'S 19D423266G4 & G8):
   A. IF THE RECEIVER HAS LESS THAN 8 ICOMS, REMOVE C407, C412, C417. REPLACE C407 WITH C2317 (8pF, N80). REPLACE C412 WITH C2321 (3pF, NPO).
   B. IF THE RECEIVER HAS MORE THAN 8 ICOMS, REMOVE C407, C412, C417. REPLACE C407 WITH C2316 (5pF, N80). REPLACE C412 WITH C2321 (3pF, NP0).
4. SOLDER ALL ELECTRICAL CONNECTIONS. DISCARD CAPACITORS NOT USED.
5. IN APPLICATION OF THIS KIT THE CRYSTAL OSCILLATOR FREQUENCY MUST BE CHANGED PER THE FOLLOWING FORMULA:

$$FX = \frac{Fo + 11.2}{27}$$

6. MARK ALL OSC/MULT BD'S (19D423266) WITH A BLUE COLOR DOT IN THE AREA OF THE PL DRAWING NO. PER 19A115740P1.
7. APPLY LABEL (19A130206P3) TO SIDE OF PLASTIC FRAME.
8. TEST AND ALIGN PER NORMAL PROCEDURE.



PARTIAL VIEW
OSC/MULT BD. PL 19D423266



HIGH SIDE INJECTION

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FRONT END ALIGNMENT

EQUIPMENT REQUIRED

1. Test Set Models 4EX3A11, 4EX8K12, or 20,000 ohms-per-Volt multimeter with a 1 Volt scale.

2. A 406-512 MHz signal source.

PRELIMINARY CHECKS AND ADJUSTMENTS

1. Connect black plug from Test Set to Receiver Centralized Metering Jack J601, and red plug to system board metering jack J905. Set meter sensitivity switch to the TEST 1 position (or 1-Volt position on 4EX8K12).

2. For multi-frequency receivers with a frequency spacing up to 0.800 MHz for frequency range of 406-470 MHz, 0.900 MHz for frequency range of 470-494 MHz or 0.750 MHz for frequency range of 494-512 MHz, align the receiver on the channel nearest center frequency.

For multi-frequency receivers with a frequency spacing exceeding the above but no greater than 1.60 MHz for frequency range of 406-470 MHz, 1.80 MHz for frequency range of 470-494 MHz, or 1.50 MHz for frequency range of 494-512 MHz, align the receiver using a center frequency tune-up ICOM. These limits can be extended to 2.00 MHz, 2.30 MHz and 2.00 MHz respectively, with 3 dB degradation in standard receiver specifications.

3. With Test Set in Position J, check for regulated +10 Volts. If using multimeter, measure between J905-3 (+) and J905-9 (-).

4. If using multimeter, connect the negative lead to J601-9 (A-).

5. Disable Channel Guard.

ALIGNMENT PROCEDURE

STEP	METERING POSITION: TEST SET	METERING POSITION: INTERNAL METERING	METERING POSITION: MULTIMETER -AT J601-9	TUNING CONTROL	METER READING	PROCEDURE
OSCILLATOR/MULTIPLIER						
1.	C (MULT-1)	3 (MULT-1)	Pin 3	C406	Maximum	Tune C406 for maximum meter reading.
2.				C411, C416, C306, C307 and C308	See Procedure	Preset C411 and C416 to a position similar to C406. Next, preset C306, C307 and C308 fully counterclockwise. (Minimum capacity.)
3.	D (MULT-2)	4 (MULT-2)	Pin 4	C411, C416, C406	See Procedure	Tune C411 and C416 for maximum meter reading. Next, retune C406, C411 and C416 for maximum meter reading. Then carefully tune C306 for a change in meter reading (peak or dip).
4.	F (MULT-3)	5 (MULT-3)	Pin 7	C306, C307 & C308	See Procedure	Carefully tune C307 and C306 for maximum meter reading. Repeat the procedure. Next, carefully tune C308 for minimum meter reading, and retune C306 for maximum meter reading. Do NOT readjust C307 and C308.
RF SELECTIVITY NOTE: IF AMP meter range is 0-700 mVdc with a high impedance DC voltmeter.						
5.	B	2 (IF AMP)	Pin 1	C301 thru C305, A303-C2, (and L2301 if present)	Maximum	Apply an on-frequency signal to antenna jack, keeping the signal below saturation. Then tune C301 through C305 and A303-C2 for maximum meter reading. In receivers with the UHS preamplifier, also tune L2301 for maximum meter reading.
6.	B	2 (IF AMP)	Pin 1	C301 thru C305, A303-C2, C306, C307 and C308 (L2301 if present)	Maximum	Apply an on-frequency signal to the antenna jack and slightly tune C301 through C305, A303-C2, (L2301 if present) for best quieting sensitivity. C306, C307 and C308 also may be tuned slightly (not to exceed 1/4 turn).

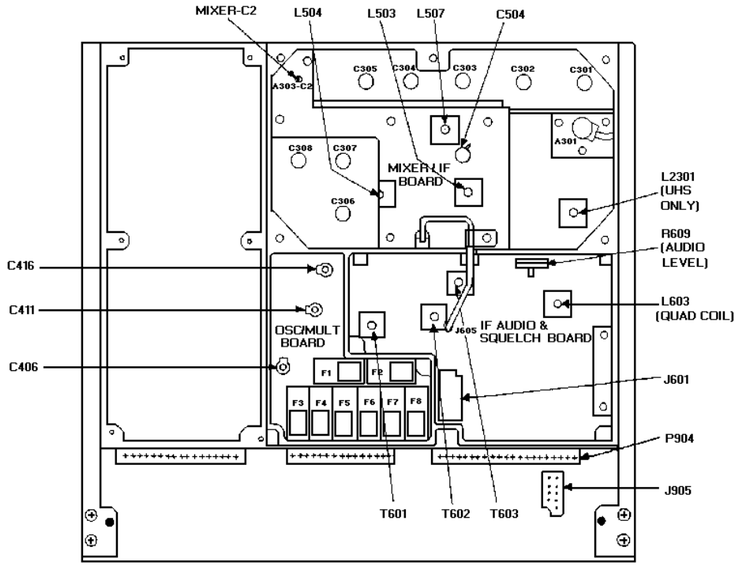

Figure 5 - Test Points And Alignment Controls

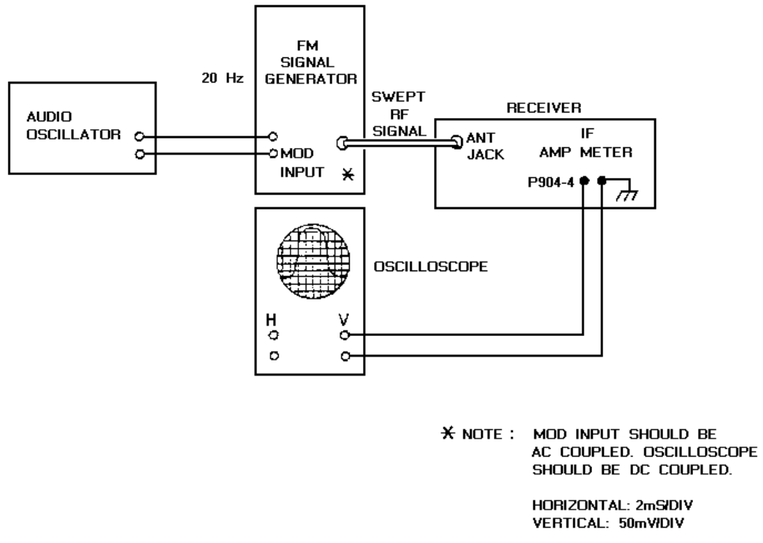

Figure 6 - Test Setup For 20 Hz Double-Trace Sweep Alignment

406-512 MHz MASTR II RECEIVER

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ICOM FREQUENCY ADJUSTMENT

First, check the frequency to determine if any adjustment is required. The frequency measurement requires equipment with an absolute accuracy which is 5 to 10 times better than the tolerance to be maintained. When performing frequency measurement, the entire radio should be as near as possible to an ambient temperature of 26.5°C (79.8°F).

MASTR II ICOMs should be reset only when the measured frequency error exceeds the following limits.

A. ±0.5 PPM, when the radio is at 26.5°C (79.8°F).

B. ±2 PPM at any other temperature within the range -5°C to +55°C (+131°F).

C. The specification limit (±2 PPM or ±5 PPM) at any temperature within the ranges -40°C to -5°C (-40°F to +23°F) or +55° to +70°C (+131°F to +158°F).

If frequency adjustment is required, lift up the cover on the top of the ICOM (where present) to expose the adjustment trimmer. Depending upon the type of frequency measuring equipment that is available, any of the following procedures may be used:

A. DIRECT MEASUREMENT IN THE INJECTION CHAIN

1. WITH A FREQUENCY COUNTER. "Count" the frequency at the junction of C416 and L403 on the Oscillator/Multiplier Board. The frequency measured at this point is 9 times the ICOM frequency. NOTE: The output from the ICOM itself is not sufficiently sinusoidal for reliable operation with most frequency counters.

2. WITH A COMMUNICATION MONITOR (for example: Cushman Model CE-3). "Monitor" frequency at the junction of C416 and L403 on the Oscillator/Multiplier Board. The frequency monitored at this point is 9 times the ICOM frequency. NOTE: This frequency will not always fall within an available measuring range of all monitors at all receiver operating frequencies.

B. STANDARD "ON FREQUENCY" SIGNAL AT THE RECEIVER INPUT (Generated from a COMMUNICATION MONITOR, for example: Cushman Model CE-3).

1. WITH A FREQUENCY COUNTER. "Count" the developed IF frequency at the top of Z602-R2 on the IFAS board. The deviation from the nominal IF frequency (11.2 MHz) in Hz is compared to the receiver operating frequency (also in Hz) to calculate error in PPM.

2. WITH AN 11.2 MHz IF FREQUENCY STANDARD (for example: Model 4EX9A10). Loosely couple the IF frequency standard to the IF signal path to create a heterodyne with the developed IF frequency. The resultant "beat frequency" can be monitored by either of the following methods:

a. Audible "beat frequency" from the receiver speaker (this requires careful frequency adjustment of the frequency standard).

NOTE

To SET ICOM frequency using "beat frequency" method, the temperature should be at 26.5°C (79.8°F). If the temperature is not 26.5°C, then offset the "on frequency" signal (at the receivers input), as a function of actual temperature, by the frequency error factor (in PPM) shown in Figure 7.

b. Observe "beat frequency" at P904-4 with an Oscilloscope.

c. With TEST SET (Meter Position B) connected to J601 on the IFAS Board, visually observe the "beat frequency" indicated by meter movement.

The frequency of the "beat" is the frequency error, related to the IF frequency. This deviation, in Hz, is compared to the receiver operating frequency, also in Hz, to calculate the error in PPM.

NOTE

The FM Detector output (meter position A of the test set) has a DC voltage of +0.35 to 0.5-Volts with an ON-FREQUENCY signal or under NO-SIGNAL conditions and is provided for routine test and measurement only. The resolution of this reading (approximately .025 V per kHz as read on a Test Set in meter position A, or 0.1 V per kHz as measured with a VTVM at P904-3 or J601-2 on the IFAS board) is inadequate for oscillator frequency setting.

If the radio is at an ambient temperature of 26.5°C (79.8°F), set the oscillator for the correct mixer frequency (ICOM FREQ. X 9).

If the radio is not an ambient temperature of 26.5°C, setting errors can be minimized as follows:

A. To hold setting error to ±0.6 PPM (which is considered reasonable for 5 PPM ICOMS):

1. Maintain the radio at 26.5°C (±5°C) and set the oscillator to require mixer injection frequency, or

2. Maintain the radio at 26.5°C (±10°C) and offset the oscillator, as a function of actual temperature, by the frequency error factor shown in Figure 7.

B. To hold setting error to ±0.35 PPM (which is considered reasonable for 2 PPM ICOMS): Maintain the unit at 26.5°C (±5°C) and offset the oscillator, as a function of actual temperature, by the frequency error factor shown in Figure 7.

For example: Assume the ambient temperature of the radio is 18.5°C (65.4°F). At that temperature, the curve shows a correction factor of 0.3 PPM. (At 138 MHz, 1 PPM is 138 Hz. At 174 MHz, 1 PPM is 174 Hz).

With a mixer injection of 150 MHz, adjust the oscillator for a corrected mixer injection frequency 45 Hz (0.3 X 150 Hz) higher. If a negative correction factor is obtained (at temperatures above 26.5°C), set the oscillator for the indicated PPM lower than the calculated mixer injection frequency.

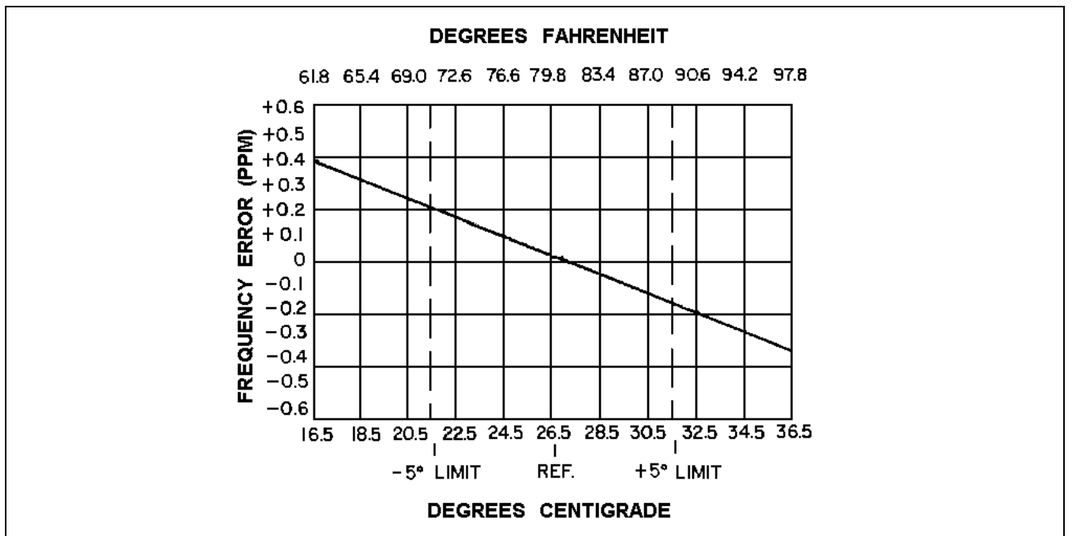


Figure 7 - Frequency Characteristics Vs. Temperature

COMPLETE RECEIVER ALIGNMENT

EQUIPMENT REQUIRED

1. Test Set Models 4EX3A11, 4EX8K12, or 20,000 ohms-per Volt multimeter with a 1- Volt scale.

2. An 11.2 MHz signal source (Test Set Model 4EX9A10). Also a 406-512 MHz signal source with a one-inch piece of insulated wire no larger than .065 inch diameter connected to generator probe.

3. DVM.

4. Distortion Analyzer.

PRELIMINARY CHECKS AND ADJUSTMENTS

1. Connect the black plug from the Test Set to receiver metering jack J601, and the red plug to system board metering jack J905. Set the meter sensitivity switch to the Test 1 (or 1- Volt position on the 4EX8K12).

For multi-frequency receivers with a frequency spacing up to 0.800 MHz for frequency range of 406-470 MHz, 0.900 MHz for frequency range of 470-494 MHz, or 0.750 MHz for frequency range of 494-512 MHz, align the receiver on the channel nearest center frequency.

For multi-frequency receivers with a frequency spacing exceeding the above but no greater than 1.60 MHz for frequency range of 406-470 MHz, 1.80 MHz for frequency range of 470-494 MHz, or 1.50 MHz for frequency range of 494-512 MHz, align the receiver using a center frequency tune-up ICOM. These limits can be extended to 2.00 MHz, 2.30 MHz and 2.00 MHz respectively, with 3 dB degradation in standard receiver specifications.

3. With the Test Set in Position J, check for regulated +10 Volts. With multimeter, measure from J905-3 to J905-9.

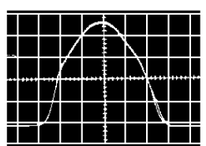
4. If using multimeter, connect the negative lead to J601-9 (A-)

5. Disable the Channel Guard.

ALIGNMENT PROCEDURE

STEP	METERING POSITION			TUNING CONTROL	METER READING	PROCEDURE
	TEST SET	INTERNAL METERING	MULTIMETER -TO J601-9			
FM DETECTOR						
1.	A (FM DET)	1 (FM DET)	Pin 2	L603	0.38 Volt	With no signal applied, adjust L603 for a meter reading of approximately 0.38 Volt.
OSCILLATOR/MULTIPLIER						
2.	C (MULT-1)	3 (MULT-1)	Pin 3	C406	Maximum	Tune C406 for maximum meter reading.
3.				C411, C416, C306, C307 and C308	See Procedure	Preset C411 and C416 to a position similar to C406. Next, preset C306, C307 and C308 fully counterclockwise (minimum capacity).
4.	D (MULT-2)	4 (MULT-2)	Pin 4	C411, C416, C406	See Procedure	Tune C411 and C416 for maximum meter reading. Next, retune C406, C411 and C416 for maximum reading. Then carefully tune C306 for a change in meter reading (peak or dip).
5.	F (MULT-3)	5 (MULT-3)	Pin 7	C306, C307 and C308	See Procedure	Carefully tune C307 and C306 for maximum meter reading. Repeat the procedure. Next carefully tune C308 for minimum meter reading. Do NOT readjust C307 and C308.

Cont'd.

STEP	METERING POSITION			TUNING CONTROL	METER READING	PROCEDURE
	TEST SET	INTERNAL METERING	MULTIMETER -AT J601-9			
RF AMP & SELECTIVITY						
NOTE: IF AMP meter range is 0-700 mVDC with a high impedance DC voltmeter.						
6.	B (IF AMP)	2 (IF AMP)	Pin 1	C305, C304 and A303-C2	Maximum	Preset A303-C2 to mid position. Apply an on-frequency signal in the hole adjacent to C304, keeping the signal below saturation. Then tune C305, C304 and then A303-C2 for maximum meter reading.
7.	B (IF AMP)	2 (IF AMP)	Pin 1	C304 and C303	Maximum	Apply an on-frequency signal in the hole adjacent to C303, keeping the signal below saturation. Then tune C304 and C303 for maximum meter reading.
8.	B (IF AMP)	2 (IF AMP)	Pin 1	C303 and C302	Maximum	Apply an on-frequency signal in the hole adjacent to C302, keeping the signal below saturation. Then tune C303 and then C302 for maximum meter reading.
9.	B (IF AMP)	2 (IF AMP)	Pin 1	C301 thru C305, A303-C2 (and L2301 if present)	Maximum	Apply an on-frequency signal to the antenna jack, keeping the signal below saturation. Then tune C301 through C305 and A303-C2 for maximum meter reading. In receivers with the UHS preamplifier, also tune L2301 for maximum meter reading.
10.	B (IF AMP)	2 (IF AMP)	Pin 1	C301 thru C305, A302-C2, C306, C307 & C308 (L2301 if present)	Maximum	Apply an on-frequency signal to the antenna jack and slightly tune C301 through C305, A303-C2 (and L2301 if present) for best quieting sensitivity. C306, C307 & C308 also may be tuned slightly not to exceed 1/4 turn).
11.				L603, R609	See Procedure	Remove the Test set metering plug from J601. Apply a 1000 microvolt signal with 1 kHz modulation and 3 kHz deviation to the antenna jack. Tune L603 for maximum voltage at 1.0 kHz and adjust R609 for 1 Volt RMS measured with a DVM at P904-11 (VOL/SQ HI) and P904-17 (A-).
MIXER & IF						
The mixer and IF circuits have been aligned at the factory and will normally require no further adjustment. If adjustment is necessary, use the procedure outlined in STEP 13. **NOTE** Refer to DATAFILE BULLETIN 1000-6 (IF Alignment of Two-Way Radio FM Receivers) for helpful suggestions on how to determine when IF Alignment is required.						
12.	L507, L503, L504 and C504, T601, T602, and T603 					Connect scope, signal generator, and probe as shown in Figure 6. Set signal generator level for 3 to 5 µV and modulate with 20 Hz at 12 kHz deviation. With probe between P904-4 (or J601-1) and A-, tune L507, L503, L504, C504, T601, T602, and T603 for double trace as shown on scope pattern. Preset T601-T603 to top of coil form before tuning.
13.					See Procedure	Check to see that modulation acceptance bandswidth is greater than ±7 kHz.

TEST PROCEDURES

These Test Procedures are designed to help you to service a receiver that is operating---but not properly. The problems encountered could be low power, poor sensitivity, distortion, limiter not operating properly, and low gain. By following the sequence of test steps starting with Step 1, the defect can be quickly localized.

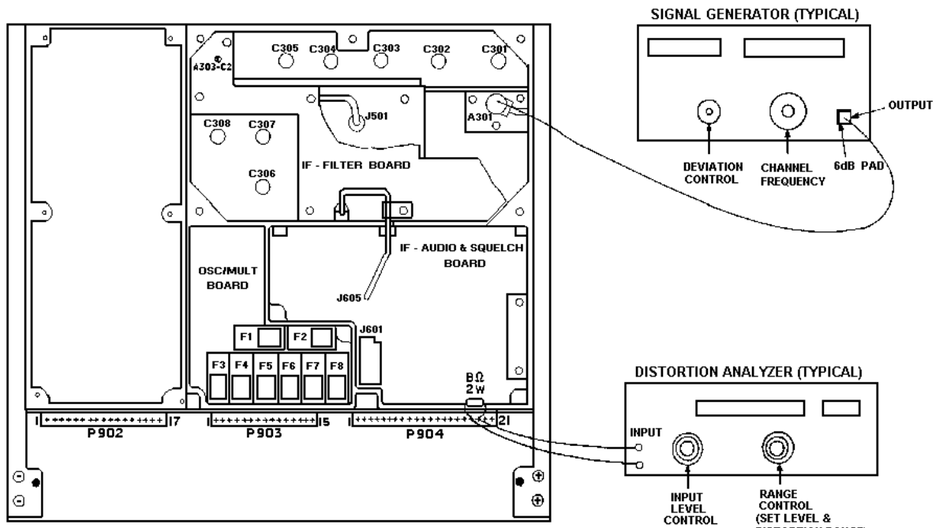
TEST EQUIPMENT REQUIRED

- Distortion Analyzer similar to:
  HP331A, or an equivalent average response meter
- Signal Generator similar to:
  HP8640B
- 6-dB attenuation pad, and 8.0 ohm, 2-Watt resistor

Once the defective stage is pin-pointed, refer to the "Service Check" listed to correct the problem. Additional corrective measures are included in the Troubleshooting Procedure. Before starting with the Receiver Test Procedures, be sure the receiver is tuned and aligned to the proper operating frequency.

PRELIMINARY ADJUSTMENTS

1. Connect the test equipment to the receiver as shown for all steps of the receiver Test Procedure.
2. Turn the SQUELCH control fully clockwise for all steps of the Test Procedure.
3. Turn on all of the equipment and let it warm up for 20 minutes.



STEP 1
AUDIO POWER OUTPUT AND DISTORTION TEST PROCEDURE

Measure Audio Power Output as follows:

A. Apply a 1,000 microvolt, on frequency test signal modulated by 1,000 Hertz with 3.0 kHz deviation to antenna jack A301-J1.

B. Disconnect speaker lead pin from System Plug P701-11 (on rear of Control Unit).
Connect an 8.0-ohm, 2-Watt load resistor from P904-19 (SPKR H1) to P904-18 (SPKR LO) or from P701-4 to P701-17 (SPKR HI) on the System Plug. Connect the Distortion Analyzer input across the resistor as shown.

OR WITH HANDSET:

Lift the handset off of the hookswitch. Connect the Distortion Analyzer input from P904-19 to P904-18.

C. Adjust the VOLUME control for one Watt output using the Distortion Analyzer as a Voltmeter.

D. Make distortion measurements according to manufacturer's instructions. Reading should be less than 3%. If the receiver sensitivity is to be measured, leave all controls and equipment as they are.

SERVICE CHECK

If the distortion is more than 3%, or maximum audio output is less than 1 Watt, make the following checks:

E. Power Supply and regulator voltage---low voltage will cause distortion. (Refer to Receiver Schematic Diagram for voltages.)

F. Audio Gain (Refer to Receiver Troubleshooting Procedure.)

G. FM Detector Alignment (Refer to Receiver Alignment.)

STEP 2
USABLE SENSITIVITY
(12 dB SINAD)

If STEP 1 checks out properly, measure the receiver sensitivity as follows:

A. Apply a 1000 microvolt, on frequency signal modulated by 1000 Hz with 3.0 kHz deviation to A301-J1.

B. With Function Switch on Distortion Analyzer set to VOLTMETER position, adjust volume control for 1.0 Watt (2.83 VRMS across 8 ohm load). Again, verify that audio output is nulled when Function Switch is set to DISTORTION position.

C. Place the RANGE switch to the SET LEVEL position (filter out of the circuit) and adjust the input LEVEL control for a +2 dB reading on a 30% range.

D. While reducing the signal generator output, switch the FUNCTION control from SET LEVEL to the DISTORTION until a 12 dB difference (+2 dB to -10 dB) is obtained between the SET LEVEL and DISTORTION positions (filter out and filter in).

E. The 12 dB difference (Signal plus Noise and Distortion to noise plus distortion ratio) is the "usable" sensitivity level. The sensitivity should be less than rated 12 dB SINAD specifications with an audio output of watt across the 8.0 ohm load.

F. Leave all controls as they are and all equipment connected if the Modulation Acceptance Bandwidth test is to be performed.

SERVICE CHECK

If the sensitivity level is more than the rated 12 dB SINAD specification, check the alignment of the RF stages as directed in the Alignment Procedure, and make the gain measurements as shown on the Troubleshooting Procedure.

STEP 3
MODULATION ACCEPTANCE
BANDWIDTH (IF BANDWIDTH)

If STEPS 1 and 2 check out properly, measure the bandwidth as follows:

A. Set the Signal Generator output for twice the microvolt reading obtained in the 12- dB SINAD measurement.

B. Set the RANGE control on the Distortion Analyzer in the SET LEVEL position (1000-Hz filter out of the circuit), and adjust the input LEVEL control for a +2 dB reading on the 30% range.

C. While increasing the deviation of the Signal Generator, switch the RANGE control from SET LEVEL to distortion range until a 12- dB difference is obtained between the SET LEVEL and distortion range readings (from +2 dB to -10 dB).

D. The deviation control reading for the 12- dB difference is the Modulation Acceptance Bandwidth of the receiver. It should be more than ±7 kHz.

SERVICE CHECK

If the Modulation Acceptance Bandwidth test does not indicate the proper width, make gain measurements as shown on the Receiver Troubleshooting Procedure.

STEP 1 - QUICK CHECKS

TEST SET CHECKS

These checks are typical readings measured with Test Set Model 4EX3A11 in the Test 1 position, or Model 4EX8K12 in the 1-Volt position.

METERING POSITION		READING WITH NO SIGNAL IN	READING WITH-10 MICROVOLTS (UNMODULATED)	TEST POSITION
A	(FM DET)	Approximately 0.38 VDC		Test 1 (or 1 Volt)
B	(IF Amp)		0.1 VDC	
C	(Mult-1)	0.4 VDC		
D	(Mult-2)	0.4 VDC		
F	(Mult-3)	0.1 VDC		
J	(Reg. +10 Volt at System Metering	+10 VDC		

SYMPTOM CHECKS

SYMPTOM	PROCEDURE
NO SUPPLY VOLTAGE	• Check power connections, continuity of supply leads. Check fuse and replace if blown. Check receiver for short circuits.
NO REGULATED 10-VOLTS	• Check the 12 Volt supply. Then check 10 Volt regulator circuit. (See Troubleshooting Procedure for 10 Volt Regulator).
LOW IF READING	• Check supply voltages and then check oscillator readings at P904-1 & -2 as shown in STEP 2. • Make SIMPLIFIED GAIN CHECKS from Mixer through Limiter Detector stages as shown in STEP 2.
LOW OSCILLATOR/MULTIPLIER READINGS	• Check alignment of Oscillator/Multiplier chain. (Refer to Front End Alignment Procedure). • Check voltage readings of Oscillator/Multiplier chain (Q401, Q402, Q403).
LOW RECEIVER SENSITIVITY	• Check Front End Alignment. (Refer to Receiver Alignment Procedure). • Check antenna connections, cable and antenna switch. • Check Oscillator injection voltage. • Check voltage readings of IF Amplifiers. • Make SIMPLIFIED GAIN CHECKS (STEP 2).

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SYMPTOM CHECKS Con't.

SYMPTOM	PROCEDURE
IMPROPER SQUELCH OPERATION	• Check voltages on Schematic Diagram. • Make gain and waveform checks with noise. • Make gain and waveform checks with 6 kHz signal. • Check discrete components in the squelch circuit. • Replace IC circuit U603.
LOW OR DISTORTED AUDIO	• Check voltages on Schematic Diagram. • Make gain and waveform checks. • Check receiver alignment and FM -DET output. • Check Q601, Q602, Q605 and other discrete components.

SQUELCH CHECKS

		SQUELCHED	UNSQUELCHED
NOISE SQ OUTPUT	U605-2	0.2 VDC	9.9V
CAS	U605-1	0.1 VDC	9.9V
$\overline{\text{RX MUTE}}$	U605-14	0.2 VDC	9.9V
RUS	U605-13	0.2 VDC	4.9V
SQ DISABLE SW. INPUT	U606-1	0.2 VDC	9.9V
AUDIO GATE SW. CONTROL	U606-11	0.2 VDC	9.9V

If External Decoder is used (CG, DCG, Type 99, etc.), $\overline{\text{RX Mute}}$ will remain low (regardless of noise squelch output), until proper response is decoded. $\overline{\text{RX Mute}}$ = Noise Sq Output• Decoder Output.

In above cases, $\overline{\text{Sq Disable}}$ is assumed high (9.9V). If $\overline{\text{Sq Disable}}$ is grounded, U606-10 = 0.2 Vdc, U606-11 = 9.9 Vdc and Unit is unsquelched for all conditions.

STEP 3-VOLTAGE RATIO READINGS

EQUIPMENT REQUIRED:

1. RF VOLTMETER
2. SIGNAL ON RECEIVER FREQUENCY (BELOW SATURATION) USE 1,000 HERTZ SIGNAL WITH 3.0KHz DEVIATION.

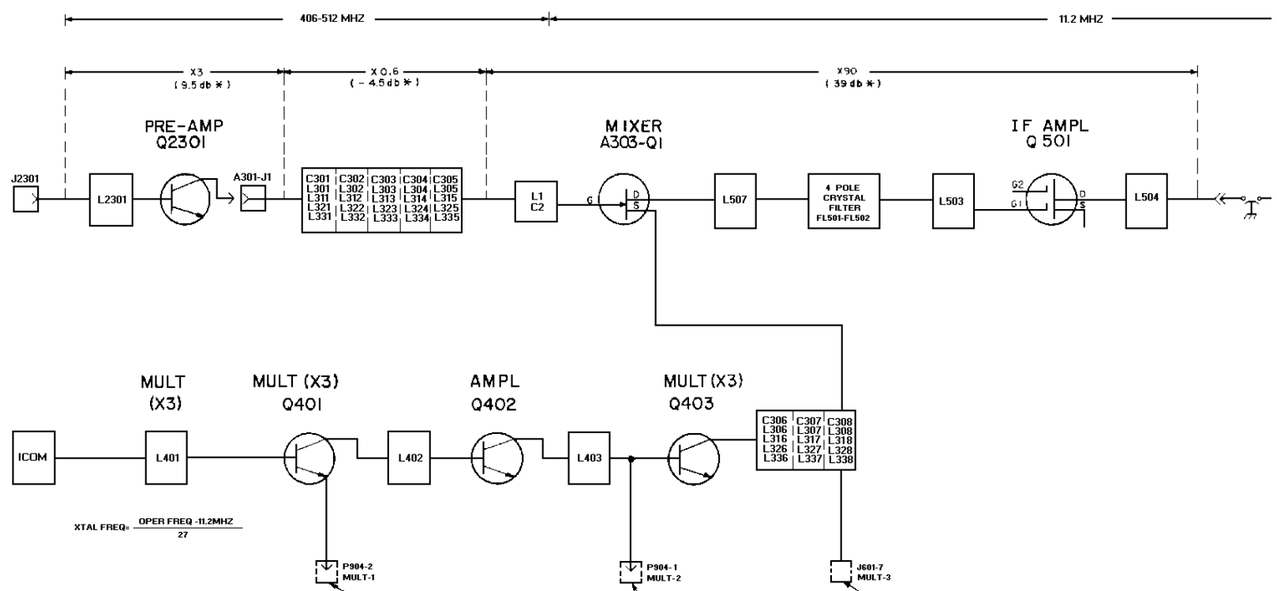
PROCEDURE:

1. APPLY PROBE TO INPUT OF STAGE (FOR EXAMPLE, SOURCE OF RF AMP). PEAK RESONANT CIRCUIT OF STAGE BEING MEASURED AND TAKE VOLTAGE READING (E_1).
2. MOVE PROBE TO INPUT OF FOLLOWING STAGE (MIXER). REPEAK FIRST RESONANT CIRCUIT THEN PEAK CIRCUIT BEING MEASURED AND TAKE READING (E_2).
3. CONVERT READINGS BY MEANS OF THE FOLLOWING FORMULA.

$$\text{VOLTAGE RATIO} = \frac{E_2}{E_1}$$

4. CHECK RESULTS WITH TYPICAL VOLTAGE RATIOS SHOWN ON DIAGRAM.

* DIFFERENCE BETWEEN INPUT AND OUTPUT READINGS ON dB SCALE OF RF VOLTMETER. NOT ACTUAL POWER GAIN.



STEP 2-SIMPLIFIED GAIN CHECKS

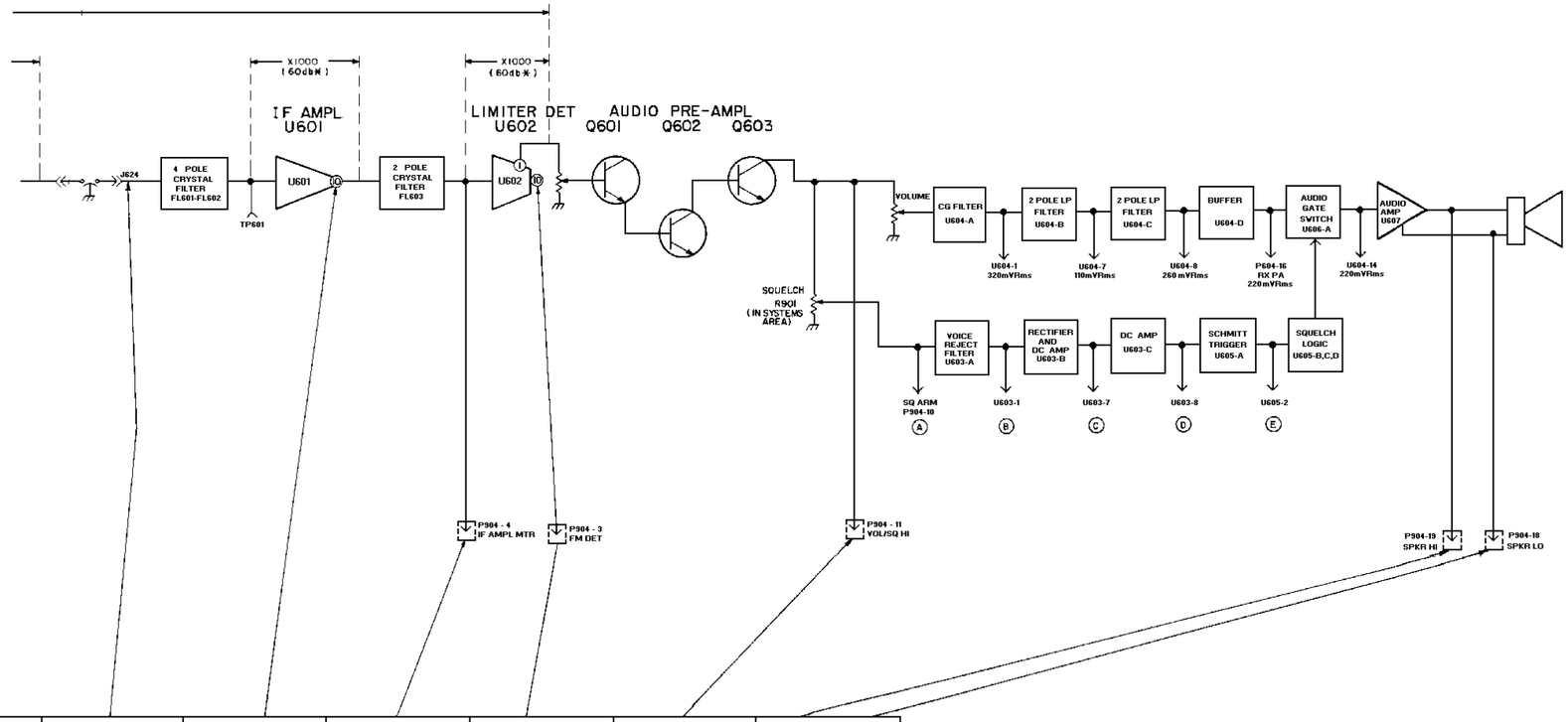
EQUIPMENT REQUIRED:

1. AC / DC VOLTMETER
2. RF SIGNAL GENERATOR
3. RF VOLTMETER

PRELIMINARY STEPS:

1. SET VOLUME CONTROL FOR 2.83 VOLTS ACROSS 8.0 OHM LOAD.
2. SET SQUELCH CONTROL FULLY COUNTERCLOCKWISE.
3. RECEIVER SHOULD BE PROPERLY ALIGNED
4. CONNECT METER BETWEEN A- AND POINTS INDICATED BY ARROW.

SIGNA APPLIED TO A301 - J1	NONE	NONE	NONE	
PROCEDURE				
READING	VOLTMETER READING SHOULD BE APPROX 0.4 VDC	VOLTMETER READING SHOULD BE APPROX 0.8 VDC	VOLTMETER READING SHOULD BE APPROX 0.5 VDC	

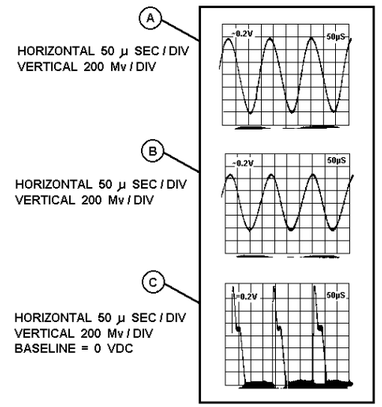


	UNMODULATED	UNMODULATED	UNMODULATED	NO SIGNAL INPUT	MODULATED	MODULATED
	SET GENERATOR OUTPUT TO 1000 MICROVOLTS AT RECEIVE FREQUENCY	RESET GENERATOR TO ZERO, THEN INCREASE OUTPUT UNTIL U601 SATURATES AS MEASURED WITH RF VOLTMETER	INCREASE GENERATOR OUTPUT FROM ZERO TO 40 MICROVOLTS	SHOULD BE IN SATURATION AT ALL TIMES	SET SIGNAL GENERATOR OUTPUT FOR 1000 MICRO-VOLTS WITH 1KHz MODULATION AND 3 KHz DEVIATION	WITH SPEAKER DISCONNECT-ED, CONNECT VOLTMETER OR SCOPE ACROSS 8 OHM LOAD CONNECTED BETWEEN P904-18 AND P904-19
	RF VOLTMETER READING SHOULD BE APPROX. 150 MILLIVOLTS	GENERATOR OUTPUT SHOULD BE APPROX. 40 MICROVOLTS (10 MICROVOLTS WITH PREAMP)	VOLTMETER READING SHOULD BE APPROX. 0.54 VDC	RF VOLTMETER READING SHOULD BE APPROX. 0.6 V_{RMS}	VOLTMETER READING SHOULD BE APPROX. 1.0 V_{RMS} , 0.7 V_{RMS} WITH VOICE GUARD	VOLTMETER READING SHOULD BE APPROX. 2.83 V_{RMS}

STEP 4 - SQUELCH WAVEFORMS

PRELIMINARY STEPS

1. QUIET RECEIVER WITH 1000 µV MODULATED SIGNAL
2. SET MODULATION FREQUENCY TO 6 KHz
3. SET DEVIATION TO 3 KHz
4. ADJUST SQUELCH POT (P901 IN SYSTEMS AREA) FOR 120 mVpp AT SQ ARM (P904 - 10)
5. USE 10 M ohm PROBE



D APPROX 3.2 VDC

E APPROX 10.0 VDC

406-512 MHz MASTR II RECEIVER